AD/A-001 698

EVALUATION OF THE BRAZILIAN RUN-FLAT TIRE

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Nevada Automotive Test Center

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13. ABSTRACT

This test program was conducted by the Nevada Automotive Test Center during the months of April through June 1974 to determine the dynamic characteristics of a combat tire system manufactured in Brazil. The 9.00-16 bias ply tires were tested on the M715, 1 1/4 ton vehicle.

Dynamic traction, rolling resistance, lateral stability and braking tests were run on wet asphalt surfaces using a standard military non-directional mud and snow bias ply tire of the same size as a control. A 5000 mile durability test over paved, secondary and cross-country surfaces and a series of 25 mile run-flat missions concluded the dynamic phase of the program. Static spring rates and footprint analyses rounded out the test program.

The combat tire system demonstrated better tractive ability, shorter stopping distance, equal rolling resistance and poorer lateral stability than the control tire used for comparison. Tires selected for the system failed in the rear wheel positions in the 5000 mile durability test but the system itself survived durability and run-flat requirements without indication of failure.

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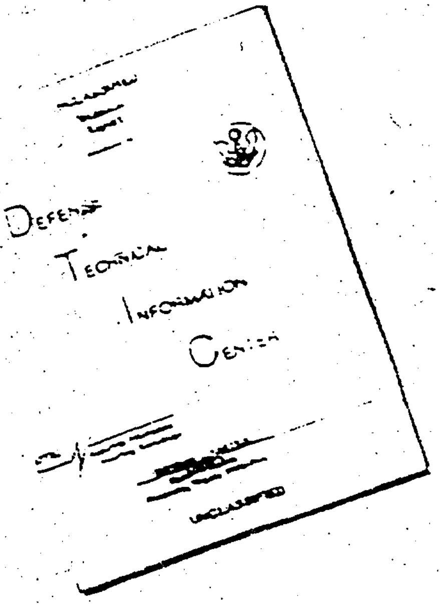

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Final Report

NATC Project 20-1-872

Technical Report No. 11923

Contract DAAE07-74-C-0109

TABLE OF CONTENTS

ABSTRACT

This test program was conducted by the Nevada Automotive Test Center during the months of April through June 1974 to determine the dynamic characteristics of a combat tire system manufactured in Brazil. The 9.00-16 bias ply tires were tested on the M715, 1 1/4 ton vehicle.

Dynamic traction, rolling resistance, lateral stability and braking tests were run on wet asphalt surfaces using a standard non-directional mud and snow military bias ply tire of the same size as a control. A 5000 mile durability test over paved, secondary and cross-country surfaces and a series of 25 mile run-flat missions concluded the dynamic phase of the program. Static spring rates and footprint analyses rounded out the test program.

The combat tire system demonstrated better tractive ability, shorter stopping distance, equal rolling resistance and poorer lateral stability than the control tire used for comparison. Tires selected for the system failed in the rear wheel positions in the 5000 mile durability test, but the system itself survived durability and run-flat requirements without indication of failure.

INTRODUCTION

This test program was representative of the military's continuing research to upgrade mobility of wheeled combat vehicles. The feasibility of introducing a combat tire with run-flat capability into the system is not questioned. In terms of logistics, mission completions and improved overall support, a suitable and dependable tire system, operationally immune to a majority of the known general hazards in combat areas would greatly increase efficient support and reduce the volume of units necessary for the same number of missions.

The vast number of applications and requirements, coupled with the known failure-producing obstacles tires are exposed to, present a never ending challenge to research to improve existing technologies and to design and develop new systems. The present state of the art of tire technology dictates much of the criteria which must be adhered to for successful results but as needs change, technology is advanced - overcoming today's problems and moving to a better product.

1.0 TEST OBJECTIVE

The objective of this test program was to evaluate durability and tractive ability of a run-flat combat tubeless tire.

During the durability phase of testing, the tire system was exposed to a combination of paved high speed and low speed operation over various cross-country terrains.

The engineering phase of the test program studied the tire system's response to lateral stability and tractive ability compared to a standard military non-directional mud and snow (N.D.M.S.) tire of the same size.

2.3 [illegible]

[illegible], [illegible] in [illegible], in the dynamic traction test was [illegible] to twelve percent [illegible] for the Brazilian combat tire in comparison to the standard military N.D.M.S. tires.

Rolling resistance was essentially equal for the two tire groups.

Stopping distance [illegible] mile per hour wet asphalt braking was two to seven percent [illegible] for the Brazilian combat tire than the standard military [illegible] tires.

All of the above results are attributable to the stiff carcass construction and low Shore "A" durometer of the compound in the Brazilian combat tire.

Lateral stability of the two groups in "J" Turn testing is more favorable for the standard military N.D.C.C. tire at higher inflations [illegible] and [illegible], but more favorable for the Brazilian combat tire at low inflations ([illegible] psi and down).

[illegible] ground pressures are a direct result of the stiff carcass construction of the Brazilian combat tire.

Four of the Brazilian combat tires failed in rear wheel positions during the 5000 mile durability test. These failures resulted from impact damage [illegible] in the secondary and cross-country segments of the test course coupled with the high pressure/temperature build-up during the high speed paved operation. The front tires on the M715 test vehicle completed the 5000 mile requirement without failure.

The Brazilian combat tire system was successful in all run-flat testing. Vehicle stability and handling were very good, no bead unseating was experienced and final inspection of the solid insert showed no damage.

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3.0 CONCLUSIONS

The run-flat aspect of the Brazilian combat tire system operated successfully. The solid rubber insert prevented bead unseating and limited the deflection after air loss, allowing near normal vehicle handling and stability characteristics.

The heavy inner liner construction of the tire created an exceptionally stiff carcass and crown resulting in fabric damage and ultimately failure in four of the tires tested.

The two piece tubeless rim design was satisfactory but those tested were poorly fabricated.

Performance of the Brazilian combat tire system in engineering tests was favorable compared to the standard military N.D.M.S. tires.

4.0 RECOMMENDATIONS

To further demonstrate the capabilities of this combat tire system, it is recommended that a more suitable selection of a tire be made. A tubeless 9.00-16 bias or radial ply tire, especially one with steel construction, would be more compatible with this system than the nylon bias ply with the heavy inner liner supplied for the test.

A reduction in sidewall stiffness and spring rate would allow more shock absorption resulting in less damage to the carcass cords and would improve soft soil mobility.

A reduction in carcass mass would allow the system to dissipate heat more readily and to generate heat less readily.

Rim construction should be improved, providing more strength in the bead seat areas.

With these changes, more satisfactory results should be obtained in all phases of the test; tires should withstand shock loadings encountered in cross-country operation without breaking cords; generate less heat build-up on high speed pavement operation; exhibit improved lateral stability, braking distance and tractive ability.

5.0 SCOPE OF WORK

5.1 Wet Asphalt Traction and Rolling Resistance

The M715 test vehicle was loaded to recommended cross-country gross vehicle weight, 8400 pounds, with the test tires installed. After attaching the dynamometer vehicle, the test vehicle entered the wet asphalt test area. While maintaining steady-state wheel speed of 2.5 miles per hour, resistance was applied by the dynamometer vehicle until wheel slip was obtained on the test vehicle. A minimum of four runs were made at each of the three inflation pressures for both tire groups. The test vehicle was operated in two-wheel drive mode for this test.

Rolling resistance was measured on both tire groups by placing the test vehicle transmission in neutral, towing the vehicle backwards at 5 miles per hour and recording the resistance indicated on the load cell. Ten readings were recorded for each pass at each inflation pressure.

Figures 1 and 2 graphically summarize the traction results and Figure 3 summarizes the rolling resistance results.

5.2 Wet Asphalt Braking

Braking tests were performed at three inflation pressures on the M715 test vehicle loaded to recommended cross-country gross vehicle weight. A standard military N.D.M.S. bias ply tire was used for comparison purposes and the tests were conducted on a wet asphalt surface at an entrance speed of 50 miles per hour. Stopping distance was measured, in feet, from the point of brake application to vehicle standstill. A minimum of four runs were made at each inflation pressure.

5.0 SCOPE OF WORK (Contd.)

5.3 "J" Turns

"J" turns were conducted on a wet asphalt surface on the M715 loaded to recommended cross-country gross vehicle weight. The 92.5 foot radius marked on the test course represented the 90 foot radius at the centerline of the vehicle plus 2.5 feet, so that all measurements could be made relative to the position of the outside wheels.

Initial entrance speed was 10 miles per hour and was increased in predetermined speed increments until full lock steer was reached or loss of control resulted. A standard military N.D.M.S. bias ply tire was used for comparison and run at the same inflation pressures as the test tires with the exception of the zero inflation pressure possible on the test tires.

The relative difference between the positions of the front tires and the rear tires from the specified radius at the various speeds determined the lateral stability characteristics of the condition tested.

5.4 Spring Rates and Footprint Analyses

Spring rates of the test tires were determined at five inflation pressures from 15 to 50 psig. The tires were loaded from zero load to 2500 pounds and the deflection measured at each 250 pound increment of load.

Footprints of the test tires were taken at five inflation pressures and at two loads. Gross and net areas were measured by compensating polar planimeter.

5.0 SCOPE OF WORK (Contd.)

5.5 Durability Testing

The durability phase of the program was conducted on the M715 vehicle at recommended cross-country gross vehicle weight. Tires were inflated to the recommended vehicle inflation pressures of 25 psig front and 45 psig rear. The 5000 mile test was run over a test course which consisted of 70% paved, 15% improved secondary and 15% cross-country surfaces. All testing was performed at the maximum safe operating speed for the condition. The test tires were measured prior to start of test, at mid-point and at the end of test.

5.6 Run-Flat Evaluation

At the conclusion of the durability phase, a specified run-flat sequence was performed. A 25 mile course consisting of 17 miles of paved surface, 4 miles of improved secondary and 4 miles of cross-country was negotiated at maximum safe speed. Testing was conducted with the left front tire deflated, both the right front and right rear tires deflated, with the left and right rear tires deflated and with all four tires deflated. After each exercise, the affected tire(s) were reinflated to determine their capability to retain air.

6.0 DESCRIPTION OF TEST MATERIAL

Four mounted and four unmounted 9.00-16 military non-directional mud and snow nylon bias ply tires, manufactured by Firestone, with special inner liners and a solid rubber insert were received for run-flat use. The mounted tires were on two piece tubeless rims and both tires and rims were manufactured in Brazil.

The mounted tires were designated as the original test group and coded A-1 through A-4. The unmounted tires were designated spares and coded A-5 through A-8. Serial numbers were as follows:

A-1	E15U015069	A-5	E15U004953
A-2	E15U010205	A-6	E15U005599
A-3	E15U015099	A-7	E15U014002
A-4	E15U003909	A-8	E15U005455

Design of the two piece tubeless rims supplied for the test was satisfactory, however, general construction necessitated repairs to the rims throughout the test. Air loss of test tires was sustained three times during the program due to split metal in the bead seat area of the rim or retaining ring. These splits, and others which were repaired prior to air loss occurring, were the result of thin metal and/or poor welding techniques.

The comparison tires used for this test were Goodyear All Service, military 9.00-16 bias ply tires having a non-directional mud and snow tread.

7.0 DESCRIPTION OF TEST EQUIPMENT

Testing was performed on an M715 1 1/4 ton vehicle having a 230 OHC engine and locking front and rear differentials. The vehicle was payloaded to 3300 pounds on the front axle and 5100 pounds on the rear axle providing a gross vehicle weight of 8400 pounds.

3.0 [illegible]

3.1 Wet Asphalt Traction and Rolling Resistance

Chart No. 1

Traction and Rolling Resistance

Tire Type	Traction Coefficient, Peak	Traction Coefficient, Slide	Peak Drawbar, pounds	Rolling Resistance, pounds/ton
Brazilian Combat	[illegible]	[illegible]	5700	42.5
[illegible]	[illegible]	[illegible]	5700	46.2
[illegible]	[illegible]	[illegible]	5700	60.7
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	60.7

[illegible] Lower Shore "A" duro- [illegible] compound of the Brazilian combat tire gave it an advant- age over the standard military [illegible] tire on the wet surface in the traction tests. Figures 1 and 2 illustrate graphically the results of this test.

Rolling Resistance was essentially the same for both tire groups. Figure 3 graphically illustrates this comparison.

Nevada Automotive Test Center

Project: 20-1-872

DYNAMIC TRACTION
WET ASPHALT
2 WHEEL DRIVE
BRAZILIAN COMBAT
NDMS BIAS PLY

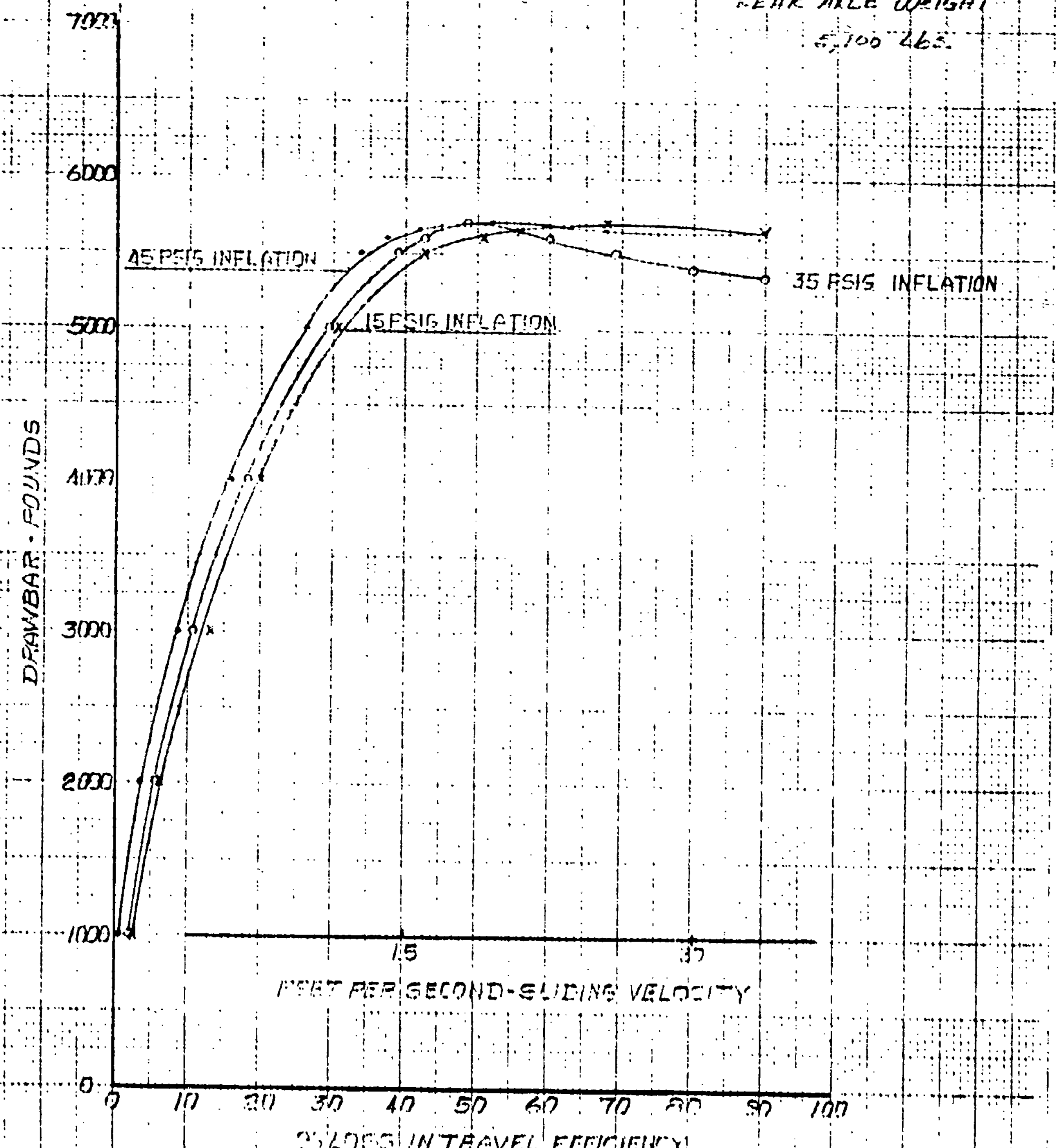
FIGURE NO. 1

Location: PROVING GROUND

Date: 5-15-74 Test By: DG

Data By: JED

AMB. TEMP. 66°F
SURF. TEMP. 58°F
REAR AXLE WEIGHT
5,700 LBS.



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Nevada Automotive Test Center

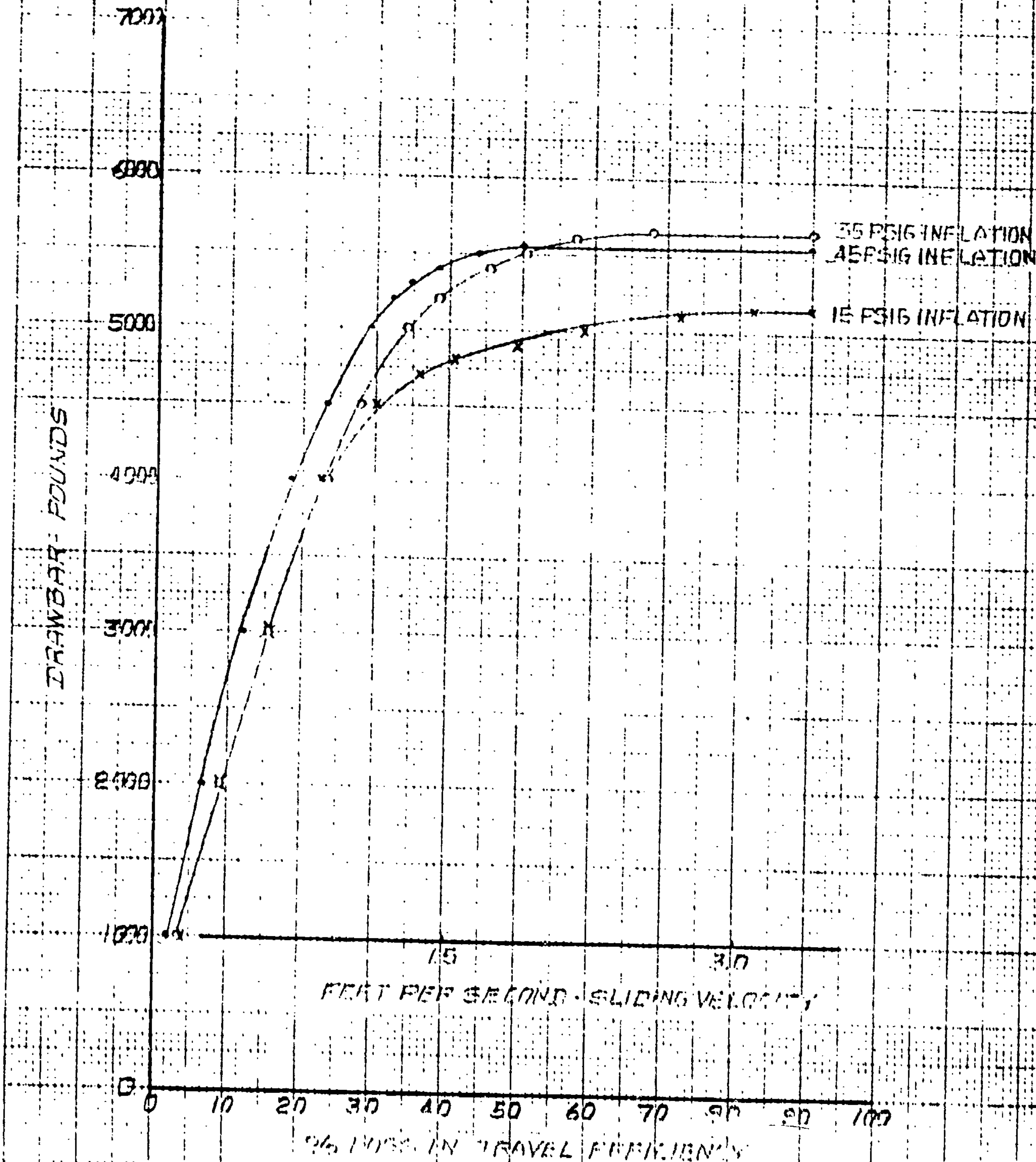
Project: 20-1-872

DYNAMIC TRACTION
WET ASPHALT
2 WHEEL DRIVE
STD. MILITARY NDMS
BIAS PLY

FIGURE NO. 2

Location: PROVING GROUND
Date: 5-15-74 Test By: DG
Data By: JED

AMB. TEMP. 66°F
SURF. TEMP. 58°F
REAR AXLE WEIGHT
5,105 LBS.



Nevada Automotive Test Center

Project: 20-1-872

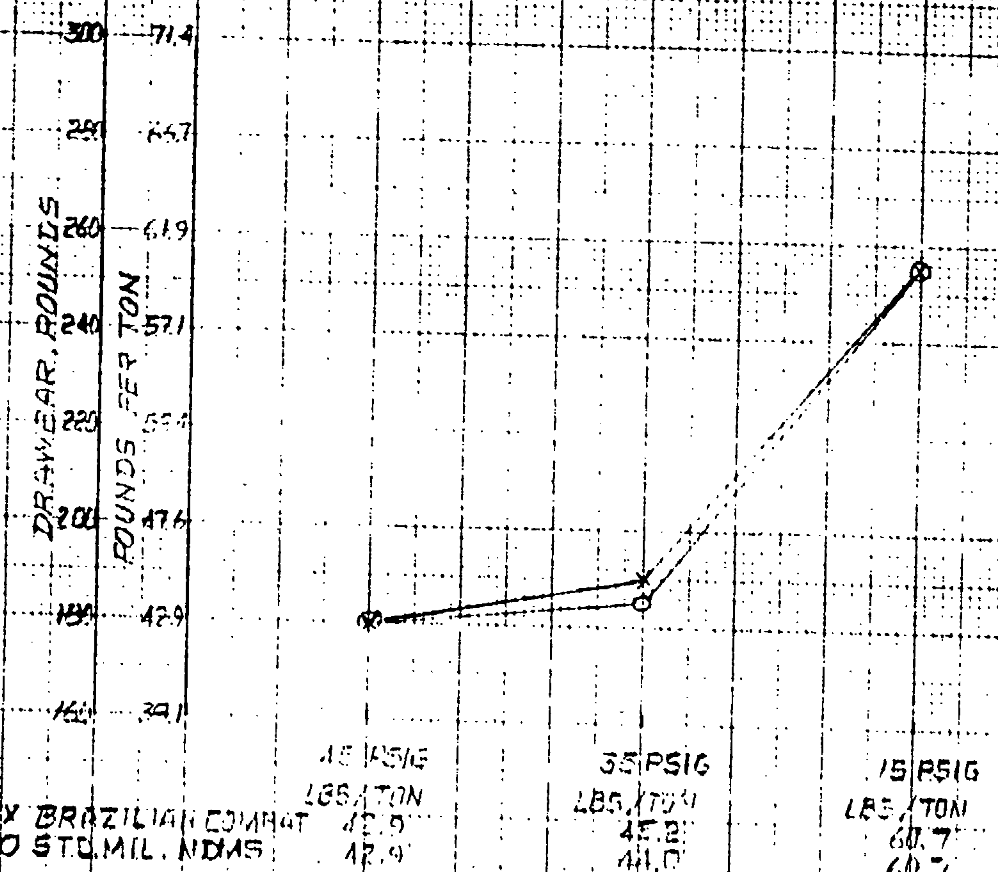
ROLLING RESISTANCE
WET ASPHALT
FIGURE NO. 3

Location: PROVING GROUND

Date: 5-15-74 Test By: DG

Data By: JED

AMB. TEMP 66°F
SURF TEMP 56°F
GVW 8400 LBS.
4.20 TONS



8.0 DISCUSSION (Contd.)

8.2 Wet Asphalt Braking

Chart No. 2

50 mph Wet Asphalt Braking

Tire Group	Inflation Press., psig Front	Rear	Stopping Distance, ft. Measured	Calculated
Brazilian Combat	25	45	148.8	146.0
N.D.M.S., bias	25	35	149.5	156.0
ply, 9.00-16	15	15	148.8	145.0
Standard Military	25	45	159.0	163.0
N.D.M.S., bias	25	35	157.8	156.0
ply, 9.00-16	15	15	151.5	153.0

As in the wet traction test, the carcass stiffness and lower Shore "A" durometer compound of the Brazilian combat tire shows an advantage over the standard military N.D.M.S. tire in stopping distance. The brake system of the M715 is not of a capacity to give locked wheel braking at the gross vehicle weight and entrance speed specified in this test.

8.0 DISCUSSION (Contd.)

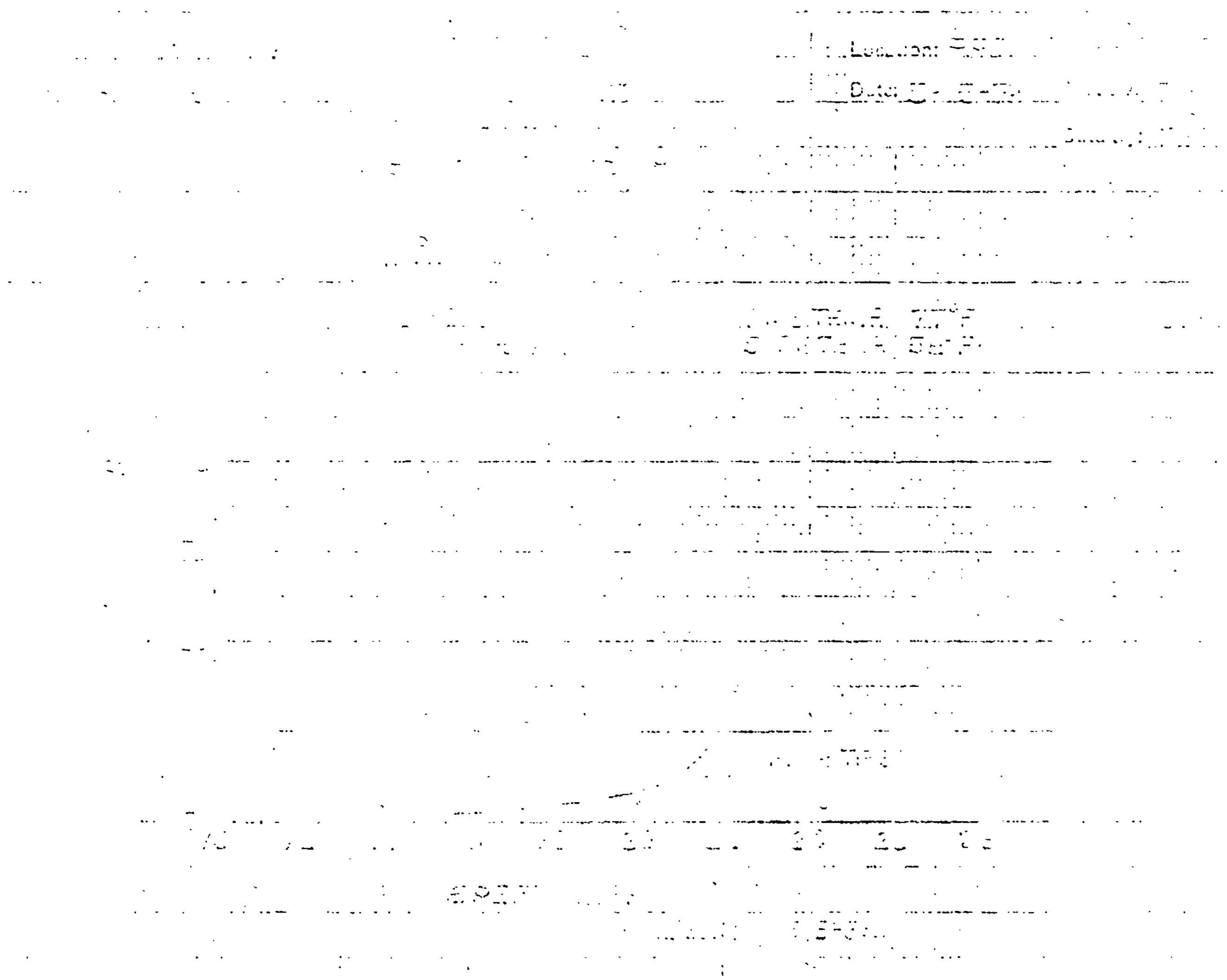
8.3 "J" Turns

Chart No. 3

Wet Asphalt "J" Turns

Tire Group	Inflation Press., psig Front	Inflation Press., psig Rear	Maximum Negotiable Speed, mph	Differential Front to Rear, inches
Brazilian Combat	25	45	21	12
N.D.M.S., bias	25	35	20	13
ply, 9.00-16	15	15	22	25
	0	0	22	26
Standard Military	25	45	22	23
N.D.M.S., bias	25	35	23	42
ply, 9.00-16	15	15	20	28

As illustrated in the above chart, the Brazilian Combat tires had less lateral stability at the higher inflation pressures than the standard military tire but showed an improvement at 15 psig front and rear over the comparison tire. At zero inflation pressure, the lateral stability of the Brazilian Combat tires was the same as at 15 psig inflation. The comparison standard military tire could not be run at zero inflation on this test. Figures 4 through 7 graphically illustrate the lateral stability degradation as speed increases.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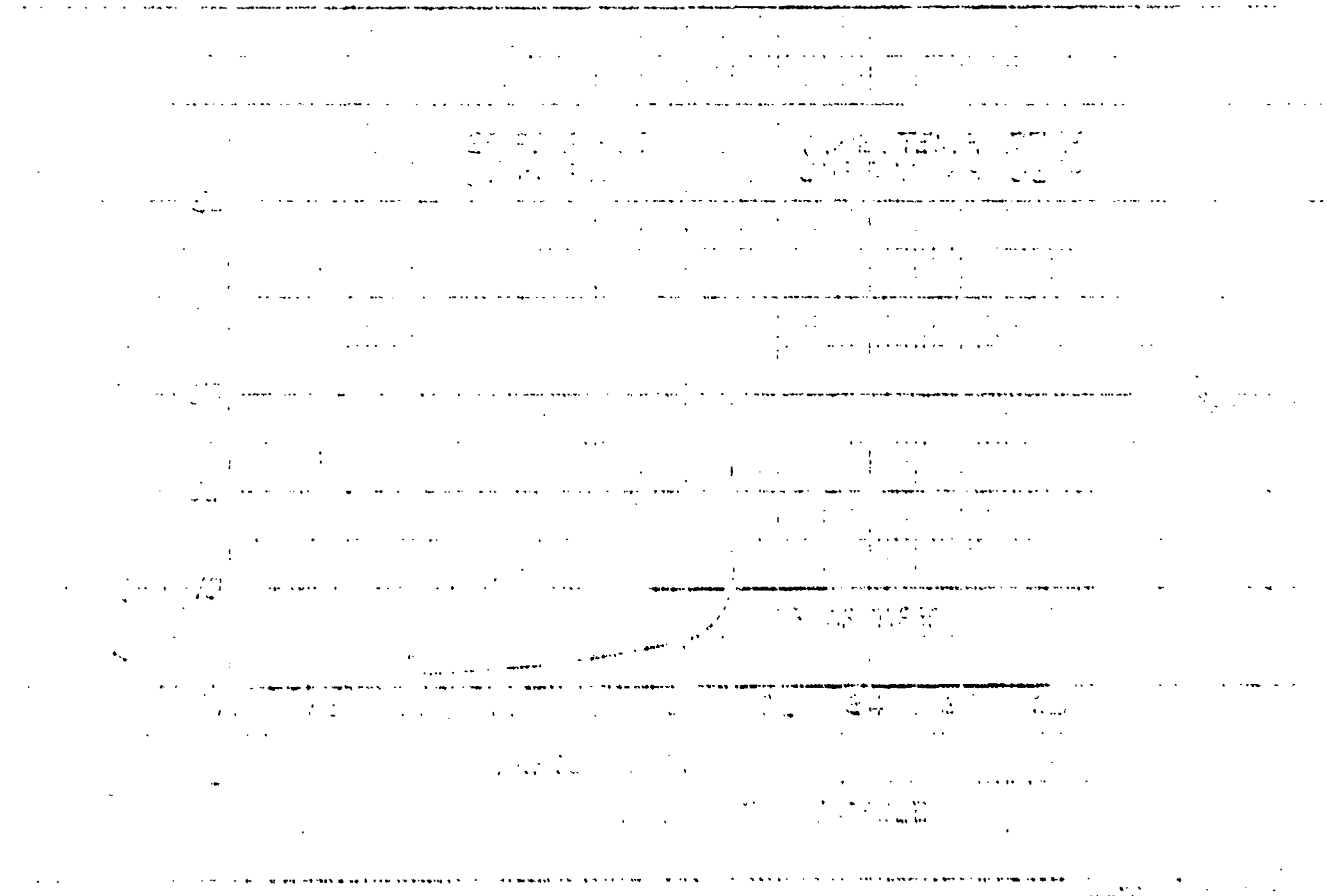

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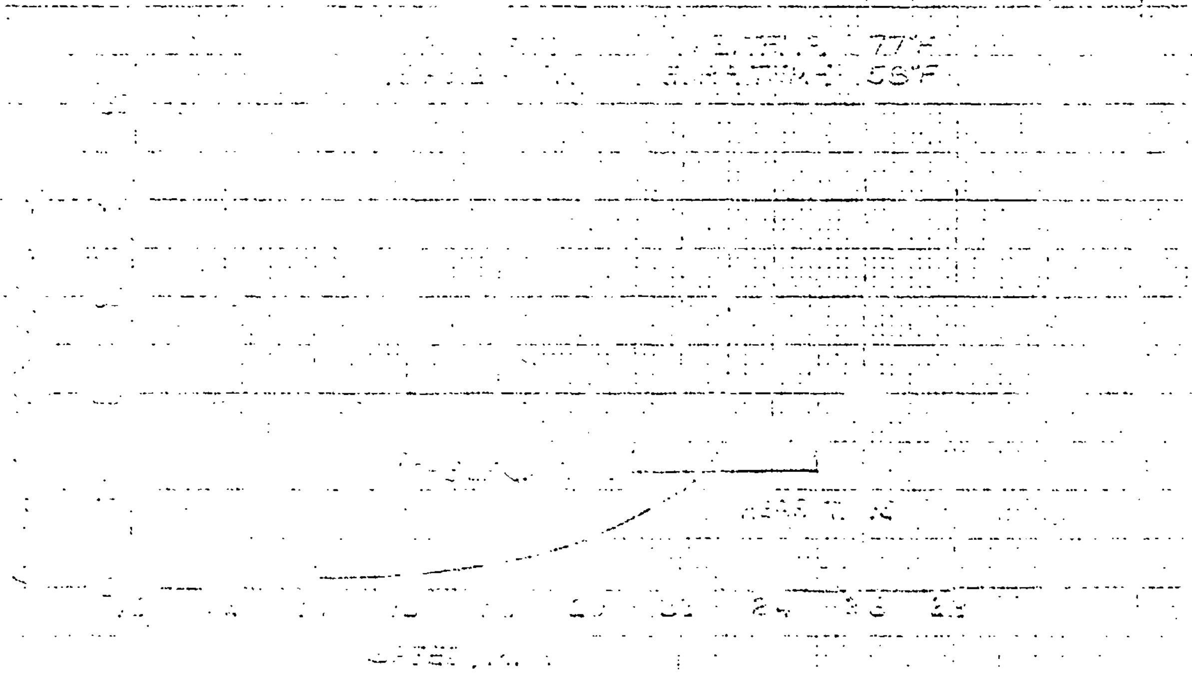

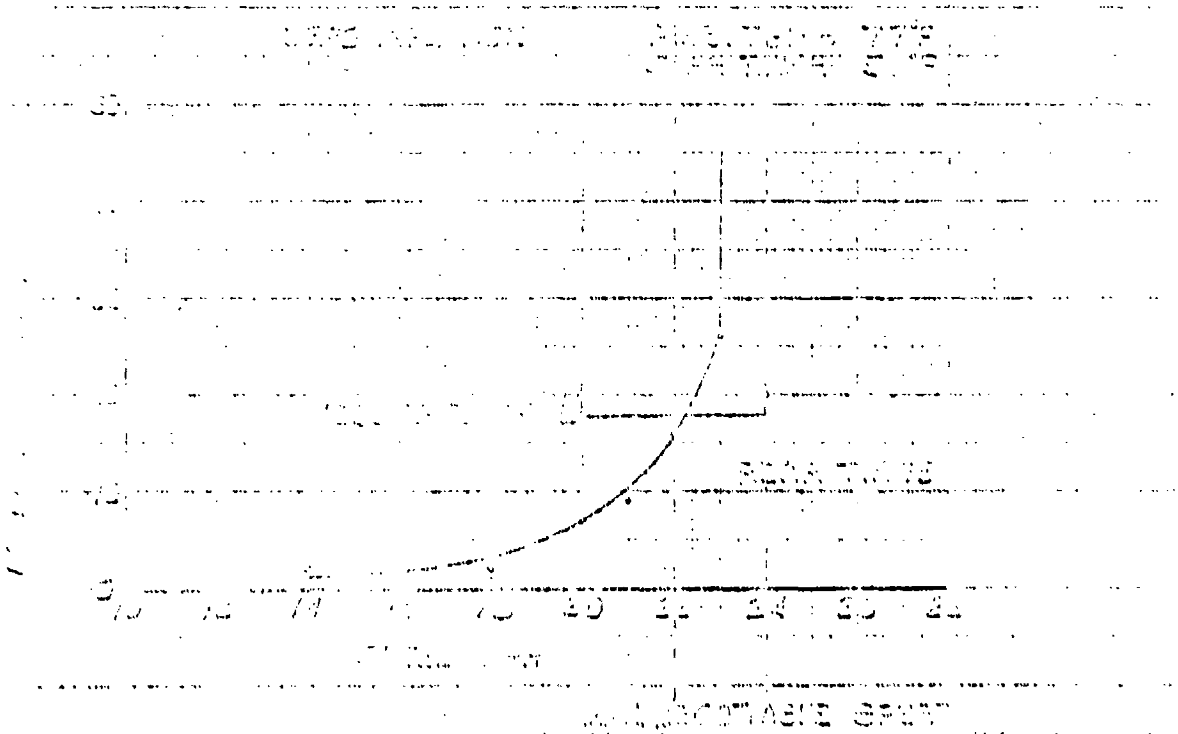

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Location:

Date:

Test By:

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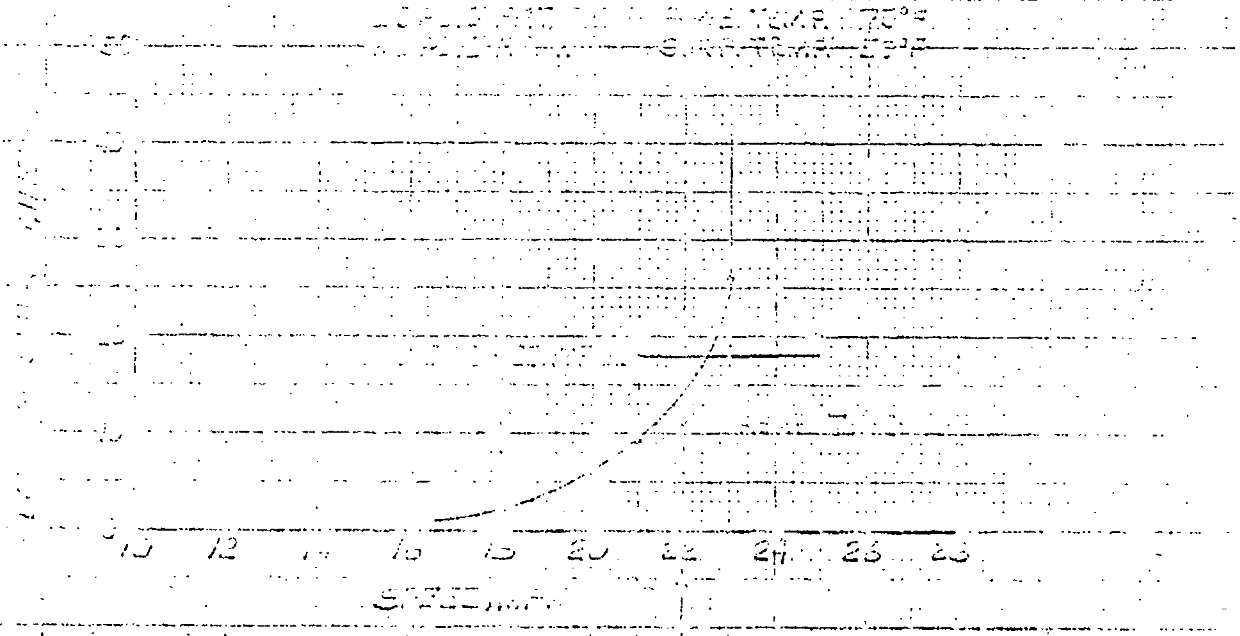
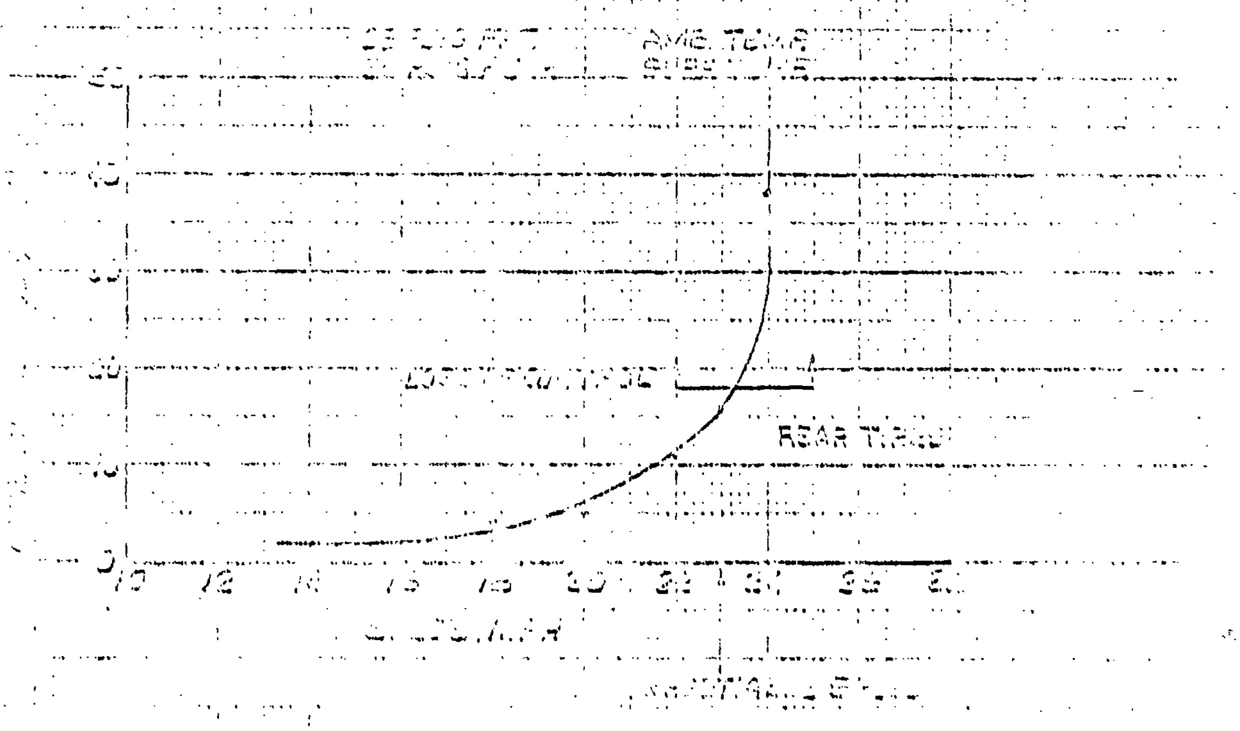




NATO FORM

Nevada Automotive Test Center

Project: 2D-L-872

Location: PROVING GROUND

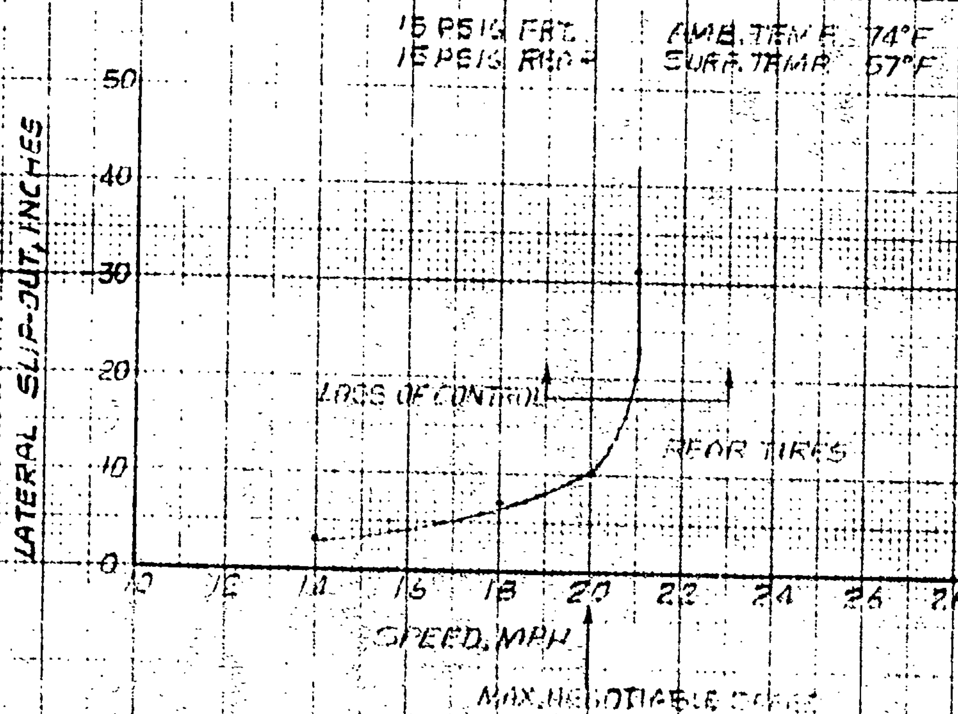
Date: 5-15-74

Test By: DLG

Data By: JED

"J" TURN
90° R DIUS
WET ASPHALT
2 WHEEL DRIVE
STANDARD MILITARY
NDMS 9.00-16

FIGURE NO. 7



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8.0 DISCUSSION (Contd.)

8.4 Spring Rates and Footprint Analyses

Chart No. 4

Spring Rates

Inflation Press., psig	Pounds Required for 1 Inch Deflection
50	2500
45	2500
35	2500
25	2000
15	1625

Chart No. 5

Footprint Length To Width

Inflation Pressure, psig	1500 Pounds Length, inches	1500 Pounds Width, inches	1500 Pounds L/W Ratio	2500 Pounds Length, inches	2500 Pounds Width, inches	2500 Pounds L/W Ratio
50	7.375	5.375	.73	8.500	6.875	.81
45	7.750	5.625	.73	8.875	7.000	.79
35	8.000	6.250	.78	9.000	7.375	.82
25	7.875	6.375	.81	9.500	7.500	.79
15	9.000	7.125	.79	10.250	7.875	.77

8.0 DISCUSSION (Contd.)

8.4 Spring Rates and Footprint Analyses (Contd.)

Chart No. 6

Footprint Net To Gross

Inflation Pressure, psig	1500 Pounds				
	Gross sq. ins.	Net sq. ins.	Pounds/Square Inch Gross	Pounds/Square Inch Net	Ratio
50	29.6	11.7	50.7	128.2	2.5
45	33.0	12.6	45.5	119.0	2.6
35	38.1	15.1	39.4	99.3	2.5
25	40.1	16.3	37.4	92.0	2.4
15	49.5	20.2	30.3	74.3	2.4

Inflation Pressure, psig	2500 Pounds				
	Gross sq. ins.	Net sq. ins.	Pounds/Square Inch Gross	Pounds/Square Inch Net	Ratio
50	45.4	18.9	55.1	132.3	2.4
45	48.8	19.2	51.2	130.2	2.5
35	52.6	22.2	47.5	112.6	2.3
25	58.9	24.4	42.4	102.5	2.4
15	66.5	28.2	37.6	88.7	2.3

Spring rates from Chart No. 4 and pounds per square inch ground pressure from Chart No. 6 indicate the high stiffness of this tire system. This analysis clearly shows how rock damage was sustained by the nylon fabric plies with resultant tire failures as experienced during the durability phase of the test program.

Figure No. 8 graphically displays the spring rates.

Naval Automotive Test Center

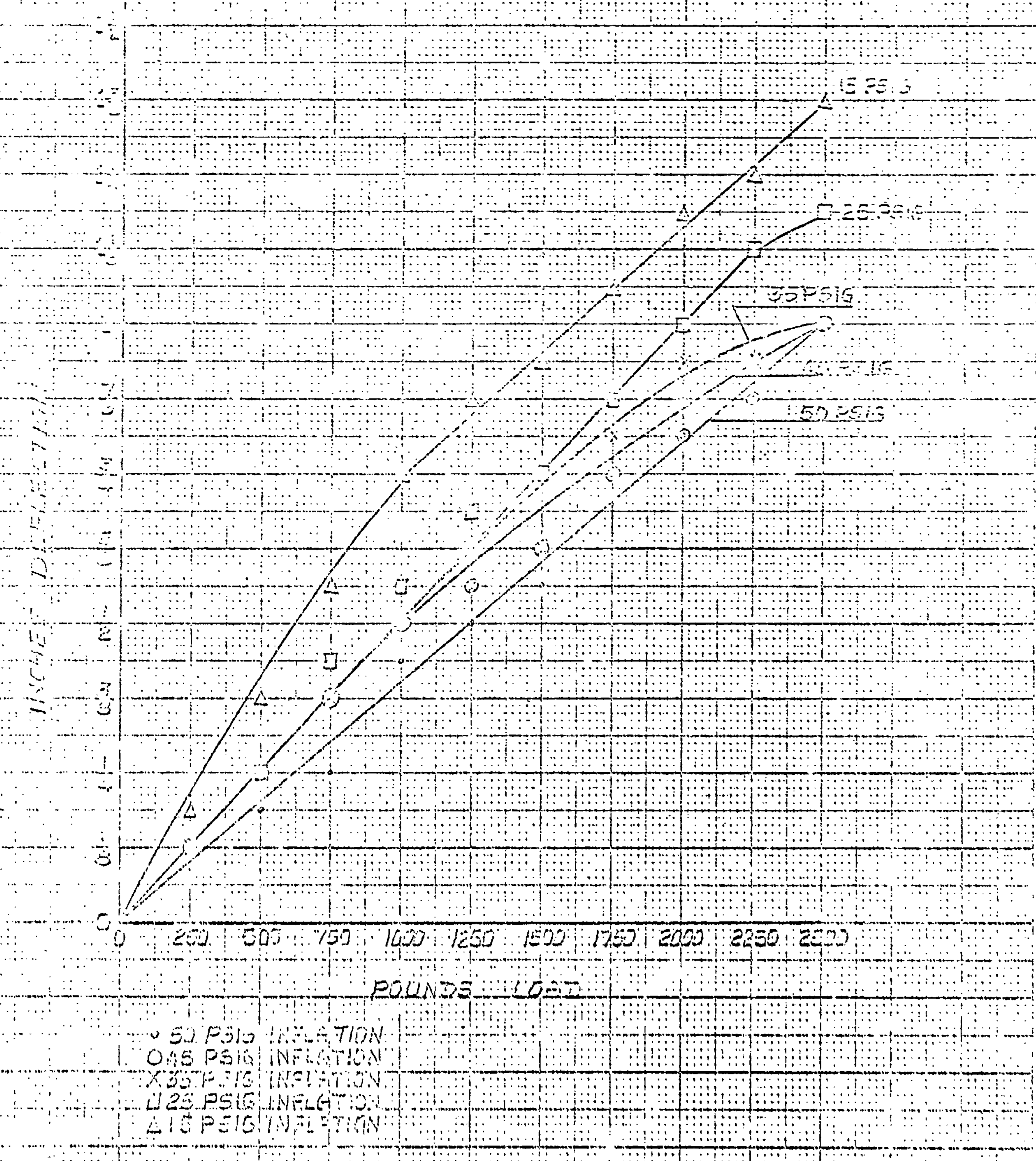
Project: 20 1-872

Location: PROVING GROUND

Date: 5-20-74 Test by:

Data By:

FIGURE NO. 5



8.0 DISCUSSION (Contd.)

8.5 Durability Testing

The M715 recommended inflation pressures of 25 psig front and 45 psig rear and recommended cross-country gross vehicle weight of 8400 pounds were utilized for the durability phase. A test course was established which provided 70% paved operation, 15% secondary and 15% cross-country surfaces. A maximum speed of 55 miles per hour was set for the paved sections, 35 miles per hour for secondary and 25 miles per hour for cross-country surfaces.

The total durability test mileage accumulated was 5002.1 at an average speed of 41.7 miles per hour. The paved mileage was 3500.7 at an average speed of 45.4 miles per hour, secondary mileage was 751 miles at an average speed of 30.2 miles per hour and 750.4 miles of cross-country were run at an average speed of 22.6 miles per hour. Total fuel consumed was 724.4 gallons for an average of 6.91 miles per gallon.

The front tires completed test without failure but a total of four tires failed in the rear wheel positions.

Tire Code/ Serial No.	Wheel Pos.	Total Test Miles	Reason For Removal
A-4 E15U003909	RR	2883.6	Sudden air loss due to massive rupture across tread. Failure may have been induced by rock impact on cross-country or secondary section of test course. Failure appears to have started 1 1/2 inches from outside sidewall in tread area under a tread lug. A slight brownish discoloration is evident at the root of the "V" shaped tear which extends across the tread to the inside should r. Approximate temperatures at time of failure were 107°F. ambient and 158°F. surface. Replaced with tire A-5, S/N E15U004953.

8.0 DISCUSSION (Contd.)

8.5 Durability Testing (Contd.)

Tire Code/ Serial No.	Wheel Pos.	Total Test Miles	Reason For Removal
A-3 E15U015069	LR	3151.0	Failure similar to A-4. Apparent separation between tread rubber and nylon plies. Two circumferential splits in tread, 3 1/2 inches apart and discoloration of cords in failed area. Approximate temperatures at time of failure were 91°F. ambient and 145°F. surface. Replaced with tire A-6, S/N E15U005599.
A-5 E15U004953	RR	1067.0	Failure similar to A-4. "Y" shaped tear across tread from inside shoulder to outside shoulder. Discolored cords and shiny area representative of prior separation which may have caused hot spots resulting in air loss. Tire was replaced by a Goodyear All Service N.D.M.S. for return to the Proving Grounds. Tire A-7, S/N E15U004692 was then installed.

8.0 DISCUSSION (Contd.)

8.5 Durability Testing (Contd.)

Tire Code/ Serial No.	Wheel Pos.	Total Test Miles	Reason For Removal
A-7 E15U004692	RR	981.4	Tire developed a large bubble, 16 inches in length, across the tread. Cutting revealed separations between carcass plies and tread stock and between carcass plies and inner liner. Carcass plies were broken in crown area and discolored in a 1 1/2 inch area. This would indicate an early separation or damage to the plies and a high heat generation in the immediate area. Replaced with tire A-8, S/N E15U005458 for the remainder of the test.

Irregular wear and excessive heel wear were evident on both of the front tires at the end of test. All tires sustained rock cuts during the test, none were to the carcass plies.

8.0 DISCUSSION (Contd.)

8.6 Run-Flat Evaluation

During the four cycles on the 25 mile run-flat course, no failure or malfunction was observed. The subjective observations and vehicle speeds were as follows:

Run No. 1 - Left front tire deflated

Maximum speed, paved:	52 mph
Average speed, secondary:	Not affected
Average speed, cross-country:	Not affected

Very slight difference in stability and handling. Moderate pull to left in four-wheel drive mode in sand.

Run No. 2 - Right front and right rear tires deflated

Maximum speed, paved:	47 mph
Average speed, secondary:	Not affected
Average speed, cross-country:	Not affected

Moderate pull to right on paved surface but no control problem under power. In the braking mode from speeds above 35 miles per hour, heavy pull to right. Moderate pull to right in sand in both two- and four-wheel drive modes.

Run No. 3 - Left and right rear tires deflated

Maximum speed, paved:	43 mph
Average speed, secondary:	Not affected
Average speed, cross-country:	Not affected

Severe rear-end steer was evident during this run. At the maximum speed on pavement, vehicle stability was marginal.

Run No. 4 - All tires deflated

Maximum speed, paved:	50 mph
Average speed, secondary:	Not affected
Average speed, cross-country:	Not affected

Vehicle handling and stability were rated equal to having all tires inflated but rolling resistance was great enough to reduce maximum speed due to limited engine torque. Speed dropped off considerably on grades. Operation in sand was improved by the increase in tire footprint.

At the end of the paved section after each run, the shoulder temperature of the deflated tire and corresponding inflated tire was measured. These values are shown in Chart No. 7.

8.0 DISCUSSION (Contd.)

8.6 Run-Flat Evaluation (Contd.)

Chart No. 7

Run-Flat Shoulder Temperatures

Run No.	Tire Pos.	Shoulder Temp. °F.	Corres. Tire	Shoulder Temp. °F.	Temperature °F. Ambient	Surface
1	LF	186	RF	154	77	104
2	RF/RR	216/251	LF/LR	129/163	81	120
3	RR/LR	262/255	RF/LF	160/129	91	130
4	RF/LF	190/192	--	---	96	135
	RR/LR	255/255				

After the final run on pavement, the solid insert and the crown of the left rear tire were probed and the recorded temperatures were 268°F. in the insert and 252°F. at the crown. The right rear insert was 258°F. and the crown was 257°F.

After each run the deflated tire or tires were inflated and checked for any leakage and none was found except where the sidewall and crown areas were probed after the fourth run.

As a final check, the left front tire was inflated to 50 psig, four 12-penny nails driven into the crown and sidewall and withdrawn. All punctures leaked.

Two of the test tires were cut, bead to bead, to inspect the inner liners and solid inserts. No sign of damage could be found in either element.

The thick rubber liner bonded to the inner liner was found to be one inch thick in the sidewall areas and reduced to 1/2 inch thick in the crown, but uniform or symetrical in contour.

Appendix I

Tire Measurement Summary

TIRE MEASUREMENT SUMMARY **HODGES TRANSPORTATION INC.** HTI Form 128MS 7-67

Proj. 30-1-872 Tire Group A Mfr. Descr. FIRESTONE OF BRAZIL
Date MAY 1974 Tire Size 9.00-16 P.R. BIAS Ribs - Type N.D.M.S. psig 35 FOR NCA Rotation FIXED WHEEL POSITION

Code Ser. Sect	Pos. Date	Meas. Miles Per	Meas. Miles Cum	Lb/Gm Loss	O.D.* % Inc	X Sec % Inc	Profile Low	Tread Arc Width	AOD AMB °F	Dur "A"	G/V-1	G/V-2	G/V-3	G/V-4	G/V-5	G/V-6	Mils Loss Per	Mils Loss Cum	Miles/Mil Per	Miles/Mil Cum	% Worn Per	% Worn Cum	Estim. Miles to Bald
A-1	LF																						
	5/8	62.6		179.4	34.60	9.95	11.00	8.10	68	60	667	671					1338	669					
	6/17	2500	2500		34.60	10.00	10.50	8.30	82	58	538	538					262	262	19.1	19.1	19.6	19.6	
	6/25	[illegible]	[illegible]		34.64	10.01	11.00	8.48	79	60	488	483					105	367	47.6	32.2	7.8	27.4	
A-2	RF																						
	5/8	62.6		179.4	34.[illegible]2	9.94	10.00	8.11	68	61	665	674					1339	670					
	6/17	2500	2500		34.53	10.00	11.00	8.30	82	59	547	535					257	257	19.5	19.5	19.2	19.2	
	6/25	[illegible]	[illegible]		34.61	10.01	11.00	[illegible]	[illegible]	59	491	491					100	357	50.0	28.0	7.5	26.7	
A-3	LR																						
	5/8	62.6		179.4	34.60	9.95	10.00	8.11	68	60													
	6/17	2500	2500		34.37	10.01	10.53	8.50	82	57													
				FAILED AT 3151.0 TEST MILES																			
A-4	RR																						
	5/8	62.6		179.4	34.62	9.94	10.00	8.10	68	60													
	6/17	2500	2500		34.90	9.99	10.50	8.50	82	56													
				FAILED AT 3383.6 TEST MILES																			
A-5	RR																						
		1067.0	1067.0	FAILED																			
A-6	LR																						
		1351.0	1351.0	END OF TEST																			
A-7	RR																						
		991.4	991.4	FAILED																			
A-8	RR																						
		70.1	70.1	END OF TEST																			

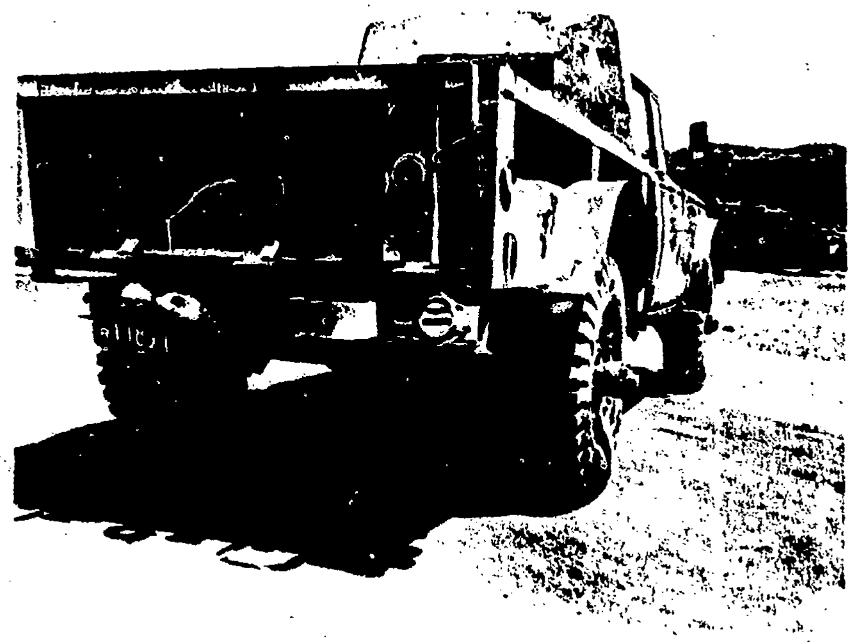
*Adjusted for tread loss. Ser.=Serial number. Sect. = Tire section. Per = Measurement Period. Cum = Cumulative
O. D. = Outside diameter. % Inc = % Increase. G/V = Groove or Void.

Appendix II

Photographic Supplement

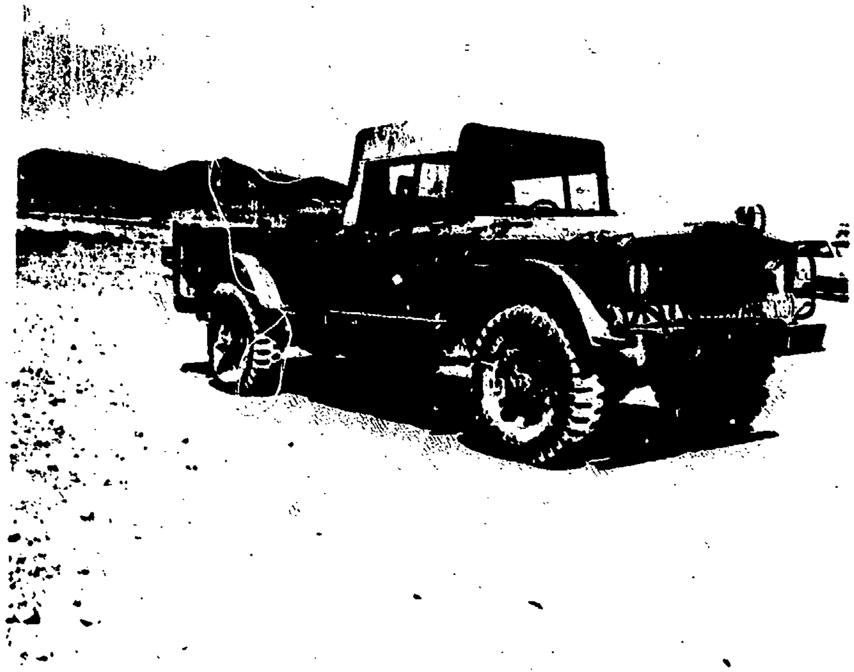
Photograph #201872-1

Component parts of the low vulnerability
tire and rim assembly



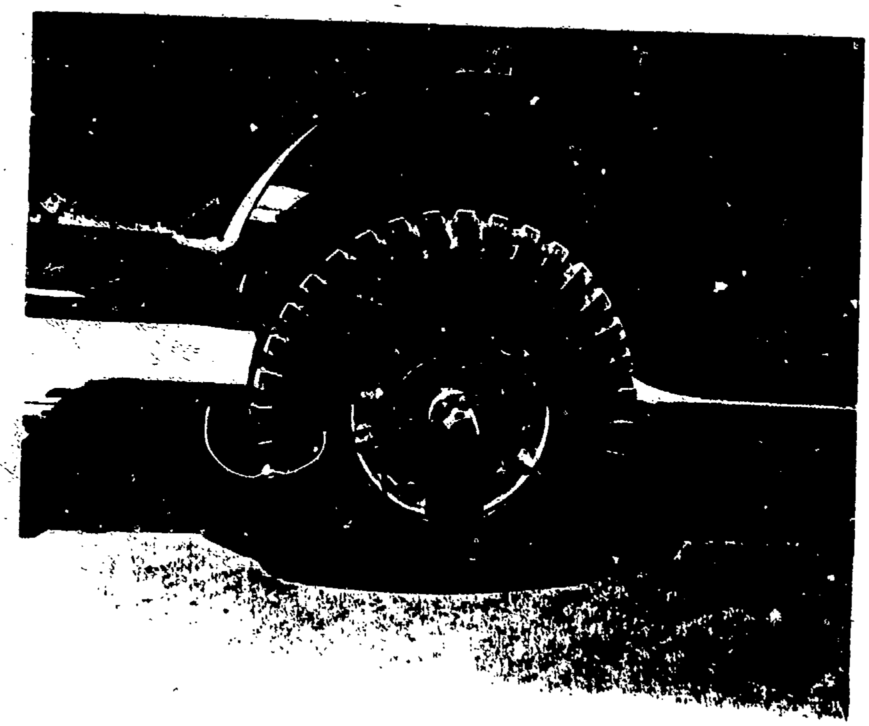
Photograph #291872-2

Test Lot with test tires inflated to recommended inflation pressures - 25 psig front, 45 psig rear



Photograph #201872-3

Test bed with test tires deflated
to zero inflation pressure



Photograph #201872-4

Deflection of rear test tire
with zero inflation pressure

Photograph #201872-5

Tire A-7
Separation failure without air loss

Photograph #201872-6

Tire A-4
Separation failure with air loss

Photograph #291972-7

Tire #8
Cross Section at separation failure area

Photograph #201872-8

Example of rim failure